Space Weather Technical Forecast

Issued on Tuesday, 21 May 2024 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares throughout. Generally quiet to unsettled (Kp0-3) geomagnetic conditions expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with the largest event a C4.8 flare at 21/0732 UTC originating from AR3683 in the southwest. There are currently eight sunspot regions on the visible disc. The largest region remains AR3685 in the southeast. It comprises of a number of large, mature spots, with recent consolidation of some of the smaller spots. AR3679 in the southwest is the next largest region, which has shown some recent growth in its trailing portion. AR3683 in the southwest shows modest complexity, although this region is becoming difficult to analyse as it approaches the west limb. The other sunspot regions are generally smaller, simpler and generally stable.

No Earth-directed CMEs were observed in the past 24 hours in coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 have been largely at background levels, but at times touching became slight elevated, ranging from 360-410 km/s. Density has been below average throughout the period. The Interplanetary Magnetic Field (IMF), Bt, was weak, with a peak of 7nT at 21/0112 UTC. The north-south component Bz fluctuated weakly from +/-6nT during the period. Phi angle was predominately positive (away from the Sun). Geomagnetic activity was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) are now at normal background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 was at background to moderate levels, with a peak of 513 pfu at 20/1410UTC. The associated 24-hour fluence has remained below the Active threshold. Observed fluence at 21/0000 UTC of 1.34e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares and a very slight chance of isolated X-class flares. AR3685 is most likely to be the source of significant flare activity.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs in the forecast, with the potential for connection to a HSS Day 4 (24 May) in associated with CH39/-.

Activity is expected to remain largely quiet to unsettled (Kp0-3), with a slight chance of Active-G1/Minor storm (Kp4-5) intervals Day 4 (24 May).

Energetic Particles / Solar Radiation: Proton flux is at background levels. There is a persistent slight chance of further enhancements should any large flares occur.

High energy electron flux, as observed by GOES-16 is at moderate levels. There is an increasing risk for the electron flux to rise and potentially reach high levels through the period. The associated 24 hour fluence is likely to remain below the active threshold initially but with a rising trend, giving a chance of exceeding the active threshold by Day 3 (23 May).

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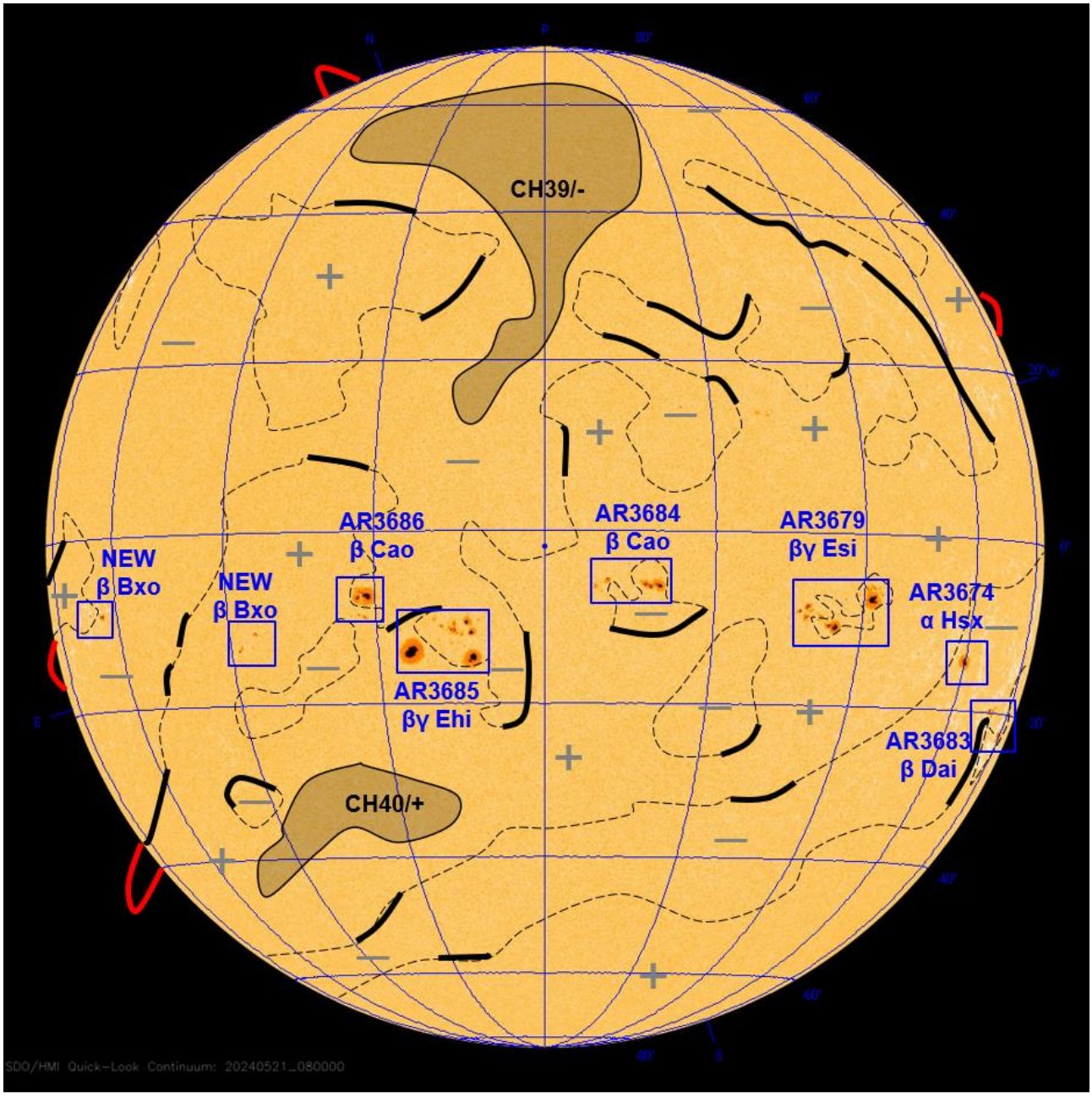
Figure 1. Solar Analysis Valid 21/1400 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth directed CMEs in the forecast. A notable full halo CME was observed leaving the sun early on 20 May, but further analysis has revealed that it is far sided, with no impact at Earth.

Towards Day 4 (24 May) a HSS in associated with CH39/- may connect with Earth. This is a new feature which was not evident on last rotation, hence confidence is low due to lack of persistence forecasting capabilities.

Activity is expected to remain largely quiet to unsettled (Kp0-3) in the absence of any Earth directed CMEs. With a slight chance of Active-G1/Minor storm (Kp4-5) intervals Day 4 (24 May) depending on the strength of connection with CH39/-.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	15
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

There are currently eight sunspot regions on the visible disc. The largest region remains AR3685 in the southeast. It comprises of a number of large, mature spots, with recent consolidation of some of the smaller spots. AR3679 in the southwest is the next largest region, which has shown some recent growth in its trailing spots. AR3683 in the southwest shows modest complexity, with some minor growth in recent hours, with a new trailer spot emerging. The other sunspot regions are generally smaller, simpler and generally stable.

No significant returning regions are expected through the period or strongly signalled in far-side sounding data, with all the current notable flare producing regions remaining on the visible disc though the next four days. As such, the current flare risks have been maintained through the period pending further developments.

Low to Moderate activity is expected with a chance of isolated M-class flares and a very slight chance of isolated X-class flares. AR3685 is most likely to be the source of significant flare activity.

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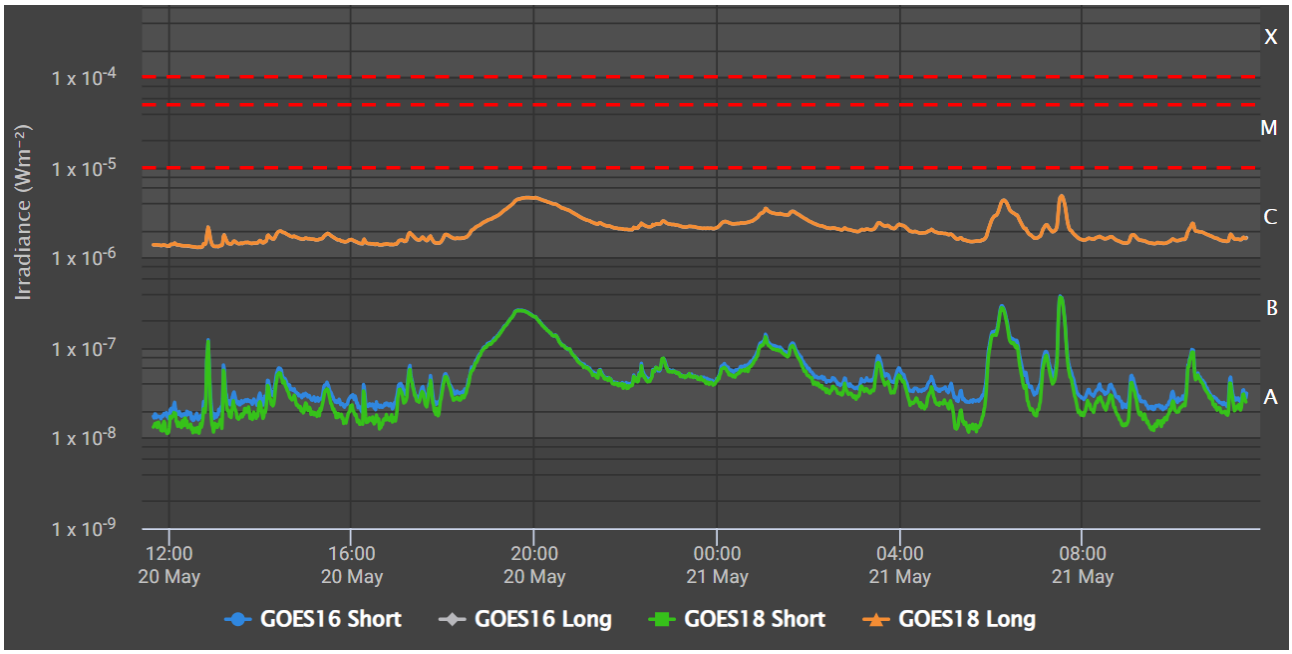
X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: GOES18 X-Ray flares trace.



Solar Radiation Storms - (High Energy Protons):

Proton flux is at normal background levels. There is a persistent slight chance of further

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enhancements should any large flares occur, especially given the number of sunspot regions on the Earth-facing disc. AR3685, the largest and most actively flaring region on the disc will, however, remain in a generally unfavourable position (in the eastern hemisphere) for significant proton enhancement throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16 is at moderate levels. There is an increasing risk for the electron flux to rise and potentially reach high levels through the period. The associated 24 hour fluence is likely to remain below the active threshold initially but with a rising trend, giving a chance of exceeding the active threshold by Day 3 (23 May). MOSWOC REFM looks to be providing reasonable guidance for a rising trend, although it is currently under representing fluence levels whilst its drop off in fluence levels later in the period is not considered accurate.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM electron fluence.

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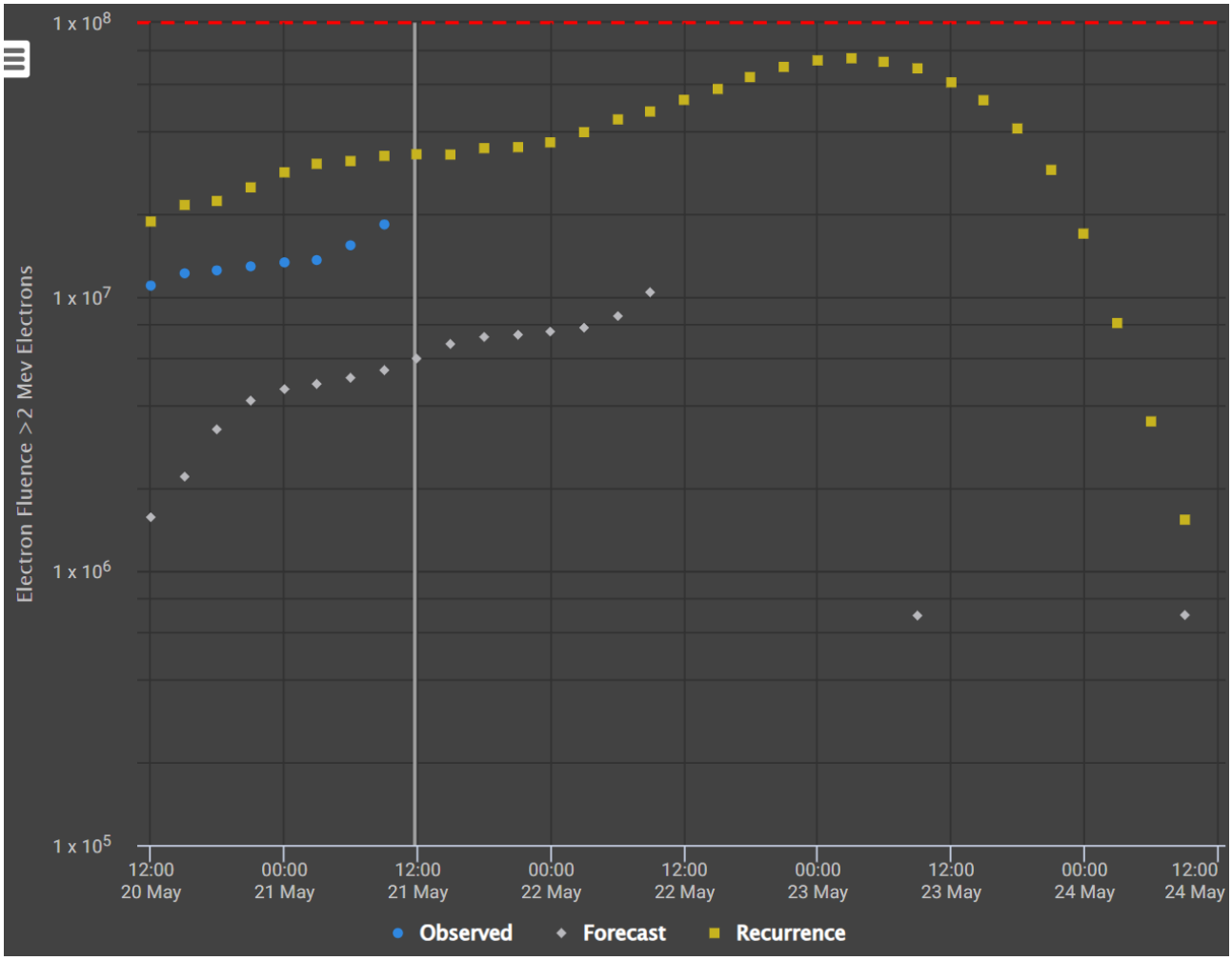

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